Amendments to the Specification:

[0014] ~~In one embodiment of the invention, a method includes (1) generating a first image pyramid of a first image, (2) generating a second image pyramid of a second image, (3) warping a first level image of the first image pyramid with a motion field, (4) determining a residual motion field from the warped first level image of the first image pyramid and a corresponding first level image of the second image pyramid, and (5) if the residual motion field is not less than a threshold, adding the residual motion field to the motion field and repeating steps (3) and (4).~~ In one embodiment, a method for processing motion frames comprises providing a first image pyramid associated with a first image and a second image pyramid associated with a second image, wherein the first and second image pyramids respectively comprise a plurality of corresponding image levels of gradual resolutions, computing a motion field comprising a plurality of motion vectors that respectively associate each pixel in the first image with a corresponding pixel in the second image, wherein the motion field is computed recursively through the image levels from a coarsest resolution to a finest resolution, and generating an intermediate image between the first image and the second image on a pixel-by-pixel basis using the motion field.

[0015] In accordance with the invention, a robust and accurate motion compensated temporal interpolation (MCTI) technique is applied in slow motion processing of digital video data to construct new intermediate frames with considerable less artifacts. As shown in Fig. 1, the slow motion processing 10 is divided into two stages: motion estimation and motion compensation. An accurate and dense motion field can be determined from each pair of consecutive frames in the original sequence. With the motion field, pixels in the original frame can be moved to appropriate locations along the motion trajectories to form pixels of a new intermediate frame. The new slow motion processed video is then formed by inserting the new intermediate frames between the original frames.

[0019] Fig. 2 illustrates an image pyramid 30 having a number of i_{max} +1 ~~(e.g., 3) number of~~ levels in one embodiment. The motion estimation begins at the highest level $L^{i_{max}}$, where a coarse motion field $d^{i_{max}}$ is obtained using an iterative motion estimator. The iterative motion estimation algorithm is detailed in the next section. The coarse motion field $d^{i_{max}}$ is then propagated to the next finer level $L^{i_{max}-1}$ ~~in~~ as an initial guess for the motion field in the iterative motion estimation at level $L^{i_{max}-1}$. As shown in Fig. 3, at each pyramid level L^{i} of frames I_{t-1} and I_t, the motion field d^{i+1} is propagated from the coarser level L^{i+1} and used as an initial guess for the motion field. Given that initial guess, the refined motion field is computed by the iterative motion estimation, and the result is propagated

to the next finer level L^{i-1}, and so on to level L^0, which represents the original frame. The final result d^0 is the desired motion field between frames I_{t-1} and I_t.

[0021] ~~The difference~~ In one embodiment, ~~to the coarse-to-fine strategy used in pyramidal~~ the motion estimation algorithm described ~~in the last section is that~~ also passes the motion field ~~is passed~~ within ~~the~~ each level of the image pyramid~~, not from coarse to finer levels~~. As shown in Fig. 4, at level L^i, the coarse motion field d^{i+1} of level L^{i+1} is propagated and used as an initial guess $d^{i'}$ for the motion field. Frame I_{t-1}^i is then warped to $I_{t-1}^{'i}$ by the initial guess $d^{i'}$. Using the HS algorithm, the residual motion r between warped frame $I_{t-1}^{'i}$ and frame I_t^i is determined, and added to the initial guess $d^{i'}$ as a refinement. The refined motion field is then used as initial guess again. The procedures of warping frame, the HS motion estimation, the motion field refining are carried out recursively, until the norm of the residual motion field r is less than a predefined threshold R_{thre}, or the iterative number n is more than a predefined threshold N_{thre}. The final result of the motion field at level L^i is propagated to next finer level L^{i-1} as the initial guess of that level according to the pyramidal motion estimation algorithm described in last section.

[0022] The above described motion estimation method combines the iterated registration method with the pyramidal motion estimation method. This method, hereafter referred as iterative pyramidal motion estimation (IPME), has two major advantages. Firstly, a lesser number of levels in the image pyramid will be needed since larger motion at each level can now be tracked. Secondly, the coarse motion estimation errors propagated to the finer levels can be recovered. At the same time, IPME algorithm has faster convergence property than that of the HS algorithm, and it is more efficient than the HS algorithm.

[0023] After the motion estimation stage between frames I_{t-1} and I_t is completed, a dense and accurate motion field d, which is the final result of motion field d^0 at level L^0, is obtained ~~determined~~. With the motion vectors in the motion field d, a matching pixel in frame I_t is found for each pixel in frame I_{t-1}. Then, along the motion trajectory, the matched pixels pair is moved to a proper pixel location on the intermediate frame I_{int} as shown in Fig. 5. In Fig. 5, λ is a parameter representing the location on the motion trajectory from frame I_{t-1} to frame I_{int} ~~I_t~~, where λ ranges from 0 (at a corresponding pixel location in frame I_{t-1}) to 1 (at a corresponding pixel location in frame I_t). Thus, a motion vector is assigned that pixel location on the frame I_{int}.